PORE-SCALE FINITE ELEMENT MODELING OF CONDUCTIVE-RADIATIVE TRANSFER WITHIN CELLULAR CERAMICS

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ABSTRACT. The determination of the effective thermal conductivity taking into account of both conduction and radiation, for complex media – such as cellular ceramics –, and at high temperature – say above 1000ºC, is still an open question. Due to high computational costs, the state-of-the-art pore-scale conductive-radiative simulations [1,2] are restricted to small volumes. We propose to extent this threshold, considering much bigger volumes, with varying porosities and different textures. The vectorial finite element framework is used for solving the emission driven radiative transfer equation within the ceramic pores, with specular reflections on boundaries. To crub the computational cost, domain decomposition method along with the preconditioned GMRES solver described in [3,4] is used to solve such problems on thousands of processes. The non linear coupling with the heat energy equation is then taken into account to access the temperature within the solid phase. The effect of the coupling is eventually highlighted by comparing the averaged temperature profiles.

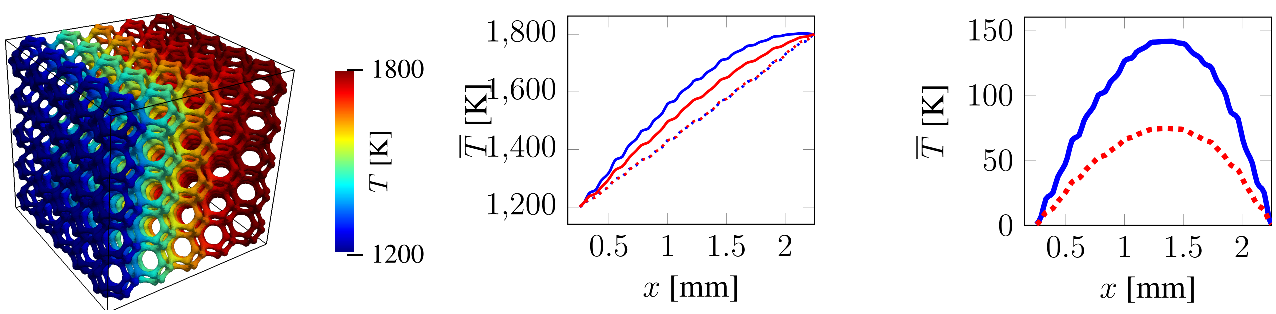

Figure 1. Left: temperature field for the 90 % porosity Kelvin cell structure. Middle: mean temperature along the x-axis: dashed line is for conduction only; plain line is for the coupling; red line is for 80 % porosity, and blue line is for 90 % porosity. Right: difference between conduction only and the coupling, for both the 90 % porosity (blue) and the 80 % porosity (red).

REFERENCES

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